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MO Mapping Orbit Reaffirmed

D. J. CASEY

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MO MAPPING ELEMENTS

- CONCLUSION LAST WEEK THAT MO MAPPING ELEMENTS WERE IN ERROR WAS INCORRECT - PROPERLY ACCOUNTING FOR INITIAL PLANET-FIXED LONGITUDE REMOVES "DISCREPANCIES"

- GRAVITY FIELD EXPRESSED USING SPHERICAL HARMONICS INCLUDES TERMS THAT DEPEND ON LATITUDE AND/OR LONGITUDE
  - 18 x 18 FIELD HAS 170 COMPONENTS (J_n or C_{nm}/S_{nm} pair)
    - 17 LATITUDE-ONLY (J_2-J_{18})
    - 17 LONGITUDE-ONLY (n = m)
    - 136 DEPEND ON BOTH LATITUDE AND LONGITUDE
- MO MAPPING ORBIT BASED ON BALMINO 18x18 GRAVITY FIELD*
  - INERTIAL ELEMENTS FOR EPOCH 06-DEC-1993 —> -179° LONGITUDE
- SALAMA / KANGAS MGS GROUNDTRACK ANALYSIS
  - USED MO MAPPING ELEMENTS WITH MGS EPOCH
    —> DIFFERENT INITIAL PLANET-FIXED LONGITUDE, 46°
  - FOUND ORBIT DID NOT HAVE ENOUGH DRIFT, ADDED 1 km TO a

*MO Trajectory Characteristics Document (Final), p. 5-8; Bass, "Mapping Orbit Grid Deviation", 312/90.2-1595, 9 March 1990

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MO MAPPING ELEMENTS

- CASEY ANALYZED MO ORBIT WITH MGS TOOLS
  - UNABLE TO GET 1993 EPOCH TO WORK, USED SALAMA DATE
  - VERIFIED SALAMA/KANGAS RESULTS - REV 328 NODE 170 km EAST
  - REWORKED MO ORBIT USING BALMINO FIELD
    - REQUIRED SEMIMAJOR AXIS 0.7 km HIGHER
- SECOND LOOK FOUND MO ELEMENTS SATISFACTORY
  - MODIFIED 1998 EPOCH BY SEVERAL HOURS TO START AT MO LONGITUDE
  - NODE DELTAS AT TARGET REV SMALL
    - POHOP: < 1 km (MO USED POHOP)
    - DPTRAJ: 128 SECONDS, 36 km
  - POSSIBLE ERROR SOURCES
    - POHOP USE OF UNNORMALIZED COEFFICIENTS (ROUND-OFF ERROR?)
    - CANNOT VERIFY ALL MO INPUT DATA, METHODS
  - REFREEZING ORBIT GIVES MODIFIED MO ELEMENTS
    - $\Delta a = -140$ m
    - $\Delta e = 0.00016$
    - $\Delta i = 0.02°$

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MO MAPPING ELEMENTS

- LONGITUDE DEPENDENCE
  - CHANGING THE INITIAL LONGITUDE OF THE MO MAPPING ORBIT CAUSED SEMIMAJOR AXIS TO VARY BY NEARLY 1 KM
  - STUDY BEGUN TO DETERMINE LONGITUDE EFFECTS ON MGS ORBIT
    - MAGNITUDE OF VARIATIONS
    - HOW TO TRANSLATE ELEMENTS DESIGNED FOR ONE LONGITUDE TO A DIFFERENT LOCATION
    - HOW VARIATIONS COMPARE TO MANEUVER EXECUTION ERRORS